

3.2. PROBABLE CAUSE

This accident was caused by a combination of factors, as reflected in the following BEA-proposed Probable Cause Statement :

The Probable Cause of this accident is the loss of control of the aircraft by the flight crew, caused by the accretion of a ridge of ice aft of the de-icing boots, upstream of the ailerons, due to a prolonged operation of Flight 4184 in a freezing drizzle environment, well beyond the aircraft's certification envelope, close to VFE, and utilizing a 15 degree flap holding configuration not provided for by the Aircraft Operating Manuals, which led to a sudden roll upset following an unexpected Aileron Hinge Moment Reversal when the crew retracted the flaps during the descent.

The contributing factors to this highly unusual chain of events are :

1. The failure of the flight crew to comply with basic procedures, to exercise proper situational awareness, cockpit resource management, and sterile cockpit procedures, in a known icing environment, which prevented them from exiting these conditions prior to the ice-induced roll event, and their lack of appropriate control inputs to recover the aircraft when the event occurred ;

2. The insufficient recognition, by Airworthiness Authorities and the aviation industry worldwide, of freezing drizzle characteristics and their potential effect on aircraft performance and controllability ;

3. The failure of Western Airworthiness Authorities to ensure that aircraft icing certification conditions adequately account for the hazards that can result from flight in conditions outside 14 CFR Part 25, Appendix C, and to adequately account for such hazards in their published aircraft icing information;

4. The lack of anticipation by the Manufacturer as well as by Airworthiness and Investigative Authorities in Europe and in the USA, prior to the post accident Edwards AFB testing program, that the ice-induced Aileron Hinge moment reversal phenomenon could occur.

5. The ATC's improper release, control, and monitoring of Flight 4184.